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CIRCULAR No. 5

FEEDING DAIRY COWS IN THE MATANUSKA REGION ALASKA

By
W. T. WHITE
Animal Husbandman, Matanuska Station

Issued October 1933

UNITED STATES DEPARTMENT OF AGRICULTURE
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[Under the supervision of the Office of Experiment Stations, United States Department of Agriculture]

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By W. T. White, *Animal Husbandman, Matanuska Station*

CONTENTS

The information given in this circular is drawn from the experience of the Alaska Agricultural Experiment Stations in handling their dairy herd at the Matanuska station and from other authoritative sources.

FACTORS DETERMINING THE PROFITABLENESS OF KEEPING DAIRY COWS

Two factors determining the profitableness of keeping dairy cows are (1) the inherent capacity of the cows to secrete milk, and (2) the methods used in feeding and in handling the herd. Capacity to produce large quantities of milk testing high in butterfat for long periods may be attained by judiciously breeding cattle having the ability to transmit their desirable characteristics to their offspring, and by constantly eliminating from the herd cows giving only an average quantity of milk. Successful feeding and handling are matters for the skill of the herdsman.

Dairy cows should have an abundance of palatable, succulent feed relatively high in protein to maintain body weight, produce a maximum flow of milk, and, in case of pregnant cows, develop energy for building the fetus. A variety of feeds may be fed successfully in the same ration for a long time. A greater variety is required by cows in heavy production than by those giving only moderate to low yields. Any change in the kind of feed should be made gradually. Abrupt changes may result in digestive disturbances with a consequent diminishing flow of milk. Pure drinking water should always be

available to dairy cows. During the winter they should be provided with moderately warm water and given sufficient daily exercise in the open to maintain them in vigorous health.

WEIGHING AND MEASURING FEEDS

Often on small dairy farms and on farms where dairying is of secondary importance, the feeds for rations are measured rather than weighed. For the sake of convenience, both weights and measures of the more important feeds are listed in table 1.

TABLE 1.—*Approximate weight and measure per quart and per pound of some feeds* [1]

Kind of feed	1 quart weighs [2]—	1 pound measures—	Kind of feed	1 quart weighs [2]—	1 pound measures—
	Pounds	*Quarts*		*Pounds*	*Quarts*
Barley	1.5	0.7	Oats	1.0	1.0
Barley meal	1.1	.9	Oatmeal	1.7	.6
Corn meal	1.5	.7	Oats, ground	.7	1.4
Cottonseed meal	1.5	.7	Oat feed	.8	1.3
Wheat	1.9	.5	Oat middlings	1.5	.7
Wheat, ground	1.7	.6	Oat hulls	.4	2.5
Gluten feed	1.3	.8	Rye	1.7	.6
Gluten meal	1.7	.6	Rye meal	1.5	.7
Linseed meal, new process	.9	1.1	Rye middlings	1.6	.6
Linseed meal, old process	1.1	.9	Rye bran	.8	1.3
Molasses, cane, or blackstrap	3.0	.3	Rye feed (shorts and bran)	1.3	.8
Molasses, feed	.8	1.3	Wheat bran	.5	2.0

[1] HENRY, W. A., and MORRISON, F. B. FEEDS AND FEEDING. Appendix table 8. Ed. 19, unabridged, 770 p. Madison. 1928.
[2] Variations in moisture cause the feed to vary in weight.

SELECTING FEEDS FOR ECONOMICAL RATIONS

The choice of a dairy ration is determined mainly by its percentage of digestible protein and the cost of the feed. Table 2 records the cost per pound of protein in various feeds at definite prices per ton.

TABLE 2.—*Comparative cost per pound of digestible crude protein in 100 pounds of typical feeds*

Kind of feed	Digestible crude protein	Total digestible nutrients	Actual cost per pound at indicated, gross price per ton [1]										
			$10	$12	$14	$16	$18	$20	$30	$40	$52	$60	$70
	Lbs.	*Lbs.*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
Cottonseed meal	37.6	80.2	1.3	1.6	1.8	2.1	2.4	2.6	4.0	5.3	6.9	7.9	9.1
Linseed meal	30.2	78.3	1.7	2.0	2.3	2.6	3.0	3.3	5.0	6.6	8.6	9.9	11.9
Gluten meal	29.7	85.8	1.7	2.0	2.3	2.6	3.0	3.3	5.1	6.7	8.7	10.1	11.9
Gluten feed	21.3	80.8	2.3	2.8	3.3	3.8	4.2	4.7	7.0	9.4	12.2	14.1	16.1
Wheat bran	12.0	59.7	4.2	5.0	5.8	6.6	7.5	8.3	12.5	16.7	21.7	25.0	29.1
Oats	9.7	70.4	5.2	6.2	7.2	8.2	9.3	10.3	15.5	20.6	26.8	30.9	36.0
Corn, dent	7.1	81.7	7.0	8.4	9.9	11.3	12.7	14.1	21.1	28.2	36.6	42.2	49.1
Barley	9.0	79.4	5.6	6.7	7.8	8.9	10.0	11.1	16.7	22.2	28.9	33.3	38.8
Alfalfa hay	10.6	61.0	4.7	5.6	6.6	7.5	8.5	9.4	14.1	18.8	24.4	28.2	32.9
Red-clover hay	7.4	49.6	6.6	8.1	9.5	10.8	12.2	13.5	20.3	28.4	34.3	39.6	46.2
Timothy hay	2.8	48.9	17.8	21.4	25.0	28.5	32.1	35.7	53.6	71.2	92.5	107.0	124.0
Oat-vetch hay	6.9	47.1	7.2	8.6	10.0	11.4	13.0	14.4	21.7	28.9	38.4	43.4	50.7
Oat hay	4.5	46.4	11.1	13.3	15.5	17.7	20.0	22.2	33.3	44.4	57.7	66.6	77.7

[1] Higher prices per ton may be easily calculated from this table by using one of the lower gross prices per ton, thus: To learn the cost of 1 pound of protein in linseed meal at $100 per ton, multiply the lower cost of the protein (at $20 per ton), 3.3 cents per pound by 5. Multiplying 3.3 by 5 equals 16.5 cents, which is the cost per pound of protein in linseed meal at $100 per ton.

MINERALS

Cattle rations containing quantities of palatable legumes and alfalfa hay are hardly likely to be deficient in calcium and phosphorus. Rations composed of vetch or peas usually are high in calcium. Those composed of wheat bran, linseed meal, or oats in considerable quantities, are rich in phosphorus, and succulent pastures generally supply ample calcium and phosphorus for daily requirements during the period the cows are on grass. When limited quantities of legume hay are fed, or the feed is deficient in mineral matter, or the cows are giving large yields of milk, the ration may be enriched by the addition of wood ashes, finely ground limestone, or chalk to supply calcium, and steamed bone meal, bone flour, or ground rock phosphate which supply both calcium and phosphorus.

Approximately 1 pound of common salt (sodium chloride) should be fed with every 100 pounds of concentrates. One half ounce of salt should be fed daily with the concentrates, and the cows should have free access to granulated, ground, pressed block, or crystallized, uncrushed salt, kept in a sheltered box in the lot. Cows giving more than 20 pounds of milk daily require considerably more salt than do cows producing less milk.

COMPARATIVE MOISTURE CONTENT OF FEEDS

Grains grown in the Matanuska region are somewhat higher in moisture content than those shipped in from the States, probably because the former are largely fed during the first year after production, whereas imported grains may have been stored for some time before being shipped. The moisture content of some of the feeds grown at the station and of similar kinds grown in the States is approximately as given in table 3:

TABLE 3.—*Average percentage of moisture in some feeds*

Kind of feed	Grown at Matanuska	Grown in the States[1]
	Percent	*Percent*
Vetch-oat hay	18.9	15.7
Oat-pea silage	70.1	69.9
Barley (hull-less)	13.5	9.3
Oats (plump)	14.8	9.2

[1] See footnote 1 to table 1, appendix table 1.

ROUGHAGES

Alfalfa.—Of the roughages, alfalfa hay generally takes first rank, producing the largest amount of digestible nutrients. It is palatable, somewhat laxative in effect, and high in protein and in calcium content. Alfalfa hay whether fed chopped or ground always should be considered a roughage.

Oat-and-vetch hay.—Sown in a mixture in the ratio of 80 to 90 pounds of oats and 25 pounds of spring vetch per acre, oats and vetch make a desirable hay for dairy cattle. When properly cured this hay compares favorably with alfalfa. The larger the proportion of vetch in the mixture, the greater its feeding value as hay.

Oat-and-pea hay.—Oats and peas sown in the ratio of 3 parts of oats to 1 part of peas produce a desirable hay but it is generally hard to cure because of its high moisture content when cut at the proper stage of maturity.

Oat hay.—Oat hay has a feeding value slightly above that of wheat hay. Oats for hay should be cut in the early milk stage.

Straw.—Straw may be fed when feed shortages occur, especially the upper and more valuable parts of exceptionally early cut oat straw, but the rejected coarse parts should be used only to bed down the animals. Rations composed of large amounts of roots or of silage may be economically fed with 6 to 10 pounds of straw of good quality provided only limited amounts of hay are available.

Timothy.—Timothy hay has a constipating effect, and should be supplemented by such feeds of a laxative nature as linseed meal, bran, or roots.

Wheat hay.—Wheat hay should be supplemented by feeds rich in protein, such as are linseed meal, gluten feed, or bran, which, however, make the ration expensive.

Silage.—Oats and peas, in the ratio of 3 parts of oats to 1 part of peas, make a succulent and palatable feed for dairy cows and produce exceptionally cheap gains.

Roots and tubers.—Approximately 2½ pounds of roots equal in feeding value 1 pound of silage. Roots and tubers may be used to furnish the succulent portion of the ration when silage cannot be had, or when less than four cows are to be fed during the winter.

Cattle eat mangels more readily than they do silage. Mangels should be fed either sliced or pulped. Since 100 pounds of mangels contain less than 10 pounds of dry matter, cows must consume 10 pounds or more to get a pound of dry matter. Dairy cattle should be limited in daily allowance of turnips or turnip tops because they impart their peculiar flavor to products made from the milk. More than 20 pounds of turnips or of rutabagas per 1,000 pounds of body weight can seldom be fed daily to dairy cows without imparting a poor flavor to the milk. At the station upwards of 25 pounds of raw potatoes were fed daily with good results. Many ill effects have been ascribed by investigators to the feeding of potatoes. Henry and Morrison[1] caution against the feeding of unripe or of sprouted potatoes because they contain much solanin, a poisonous compound. Babcock[2] states that the feeding of potatoes causes the milk to develop an undesirable flavor. Long[3] reports that "cows developed symptoms of poisoning after being fed on a large quantity of raw tubers", and that in another instance "two cows became ill after eating potato parings." More recently Dice[4] was of the opinion that potatoes do not cause any ill effect when fed to cows, and that undesirable flavors and odors in milk are acquired from the atmosphere.

CONCENTRATES

Oats, barley, wheat, and rye, when supplemented with good roughage, can be fed satisfactorily to supply the greater part of the concentrates needed, but limited quantities of such high protein con-

[1] HENRY, W. A., and MORRISON, F. B. Op. cit. p. 245. (Footnote 1, table 1.)
[2] BABCOCK, C. J. EFFECT OF FEEDING CABBAGE AND POTATOES ON FLAVOR AND ODOR OF MILK. U.S. Dept. Agr. Bul. 1297: 9. 1924.
[3] LONG, H. C. PLANTS POISONOUS TO LIVE STOCK. *In* Cambridge Agricultural Monograph, Ed. 2 rev., p. 55. Cambridge. 1924.
[4] DICE, J. R. POTATOES FOR DAIRY COWS. N.Dak. Agr. Expt. Sta. Bul. 249: 7. 1931.

centrates as linseed meal, meat meal, cottonseed meal, or soybean meal should be included for cows daily producing more than 30 pounds of milk.

Barley.—The feeding value of barley—destined to become the basic concentrate of livestock rations—is practically equal to that of corn, pound for pound, for milk production.[5] Barley should always be ground or rolled for dairy cattle.

Oats.—Oats are generally fed in the ratio of about 1 part of oats to 1 part of barley. The plumper the grain variety, the more desirable the feed for dairy cows. The oat grain is higher in crude protein than is that of either barley or corn, and also higher than barley and about equal to corn in fat content. Like barley, oats should always be crushed or rolled for cows.

Wheat.—As a dairy feed, wheat ranks below barley and oats and should always be fed mixed with other grains and always ground.

Rye.—The grain of rye is rather unpalatable when fed alone to cows. Fed in large quantities it produces a hard, dry butter. Two or three pounds at most per day per head of dry grain may be satisfactorily fed mixed with other feeds.

Milling byproducts.—Linseed meal is rich in protein, has a laxative and conditioning effect, and for this reason is easily digested. In locally grown concentrate rations, linseed meal should be fed daily at the rate of 1 to 3 pounds per head, depending on the weight of the cow, and on the amount of milk she gives. Linseed meal should be included in practically every ration for dairy cows, except in early summer when they are on fresh pasture.

Wheat middlings or shorts are fairly high in protein and in total digestible nutrients, but are heavy in character and therefore should be fed mixed with bran or with ground feeds. Wheat middlings not infrequently are low in calcium.

Wheat bran is high in crude protein, rich in phosphorus, low in calcium, and adds bulk to heavy concentrate mixtures. It is valuable especially for pregnant cows because of its beneficial laxative effect.

Gluten meal is heavy and unpalatable, and should be fed to dairy cows only when it can be purchased at a reasonable price. Gluten feed is not an economical feed for dairy cows in Alaska.

Molasses should not be fed except as an appetizer, when it should be sprinkled over unpalatable and inferior feeds, particularly good hays that have been bleached by the sun or discolored by weathering.

Commercial mixed feeds.—Commercial concentrate mixtures usually can be used profitably in Alaska only when small herds are to be fed. One pound of commercial concentrates per head should be fed for every 3 or 4 pounds of milk produced when the cow receives hay of good quality and either silage or roots. Two pounds of commercial concentrates over and above the amount fed for each 4 pounds of milk should be given when no silage but a plentiful supply of hay is fed.

SUMMER FEEDING

Pasture.—Dairy cows should not be turned to grass until it is well started if they are expected to subsist entirely thereon. Young grass is always high in moisture content, and should be supplemented with a dry forage. Cows refusing dry feed when first turned to pasture

[5] HENRY, W. A., and MORRISON, F. B. Op. cit. p. 365. (Footnote 1, table 1.)

should, nevertheless, be induced to take grain for the first 3 or 4 weeks. Cows giving high yields of milk require moderate amounts of grain as a supplement to pasture throughout the season. Cows producing 1 pound or more of butterfat per head daily require grain in addition to grass, regardless of season, if body weight and a good supply of milk are to be maintained. Both succulent feed and protein concentrates should be fed in addition to pasture when drought or limited areas cause the pasture to become short.

Soilage.—Winter rye, oats, barley, and peas are well suited for soilage. From an economical point of view silage can be used to better advantage than soiling crops, but where no silo is available the herdsman should supplement all but the best pastures with freshly cut forage. Generally soilage may be practiced economically where pastures are severely infested with mosquitoes. Because of their high moisture content and their tendency to purge cows, very immature crops are not satisfactory for soilage. However, since cows do not readily take to mature crops and do not eat enough dry forage to enable them to give a maximum flow of milk, the herdsman should either plant the same crop repeatedly, or plant a succession of such crops as oats, oats and peas, and oats and vetch to keep the supply of green feed available over an extended period.

MAINTENANCE AND PRODUCTION RATIONS

Rations for dairy cows may be divided into two classes, maintenance rations and production rations. Table 4 records the daily nutrient requirements for the maintenance of dairy cows weighing 800 to 1,400 pounds.

TABLE 4.—*Daily nutrient requirement for the maintenance of dairy cows weighing 800 to 1,400 pounds*

Weight of cow	Digestible crude protein	Total digestible nutrients	Weight of cow	Digestible crude protein	Total digestible nutrients
Pounds	*Pound*	*Pounds*	*Pounds*	*Pound*	*Pounds*
800	0.56	6.340	1,200	0.84	9.510
900	.63	7.132	1,300	.91	10.302
1,000	.70	7.925	1,400	.98	11.095
1,100	.77	8.718			

Table 5 records the daily nutrient requirement for production for dairy cows weighing 1,200 pounds.

TABLE 5.—*Daily nutrient requirement for production for dairy cows weighing 1,200 pounds*

Daily proportion of butterfat produced per 1 pound of milk	Digestible crude protein to be added per pound of milk	Total digestible nutrients to be added per pound of milk	Daily proportion of butterfat produced per 1 pound of milk	Digestible crude protein to be added per pound of milk	Total digestible nutrients to be added per pound of milk
Percent	*Pound* [1]	*Pound* [2]	*Percent*	*Pound* [1]	*Pound* [2]
2.5	0.045–0.053	0.230–0.256	5.0	0.060–0.073	0.362–0.402
3.0	.047–.057	.257–.280	5.5	.064–.077	.385–.428
3.5	.049–.061	.284–.316	6.0	.067–.081	.409–.454
4.0	.054–.065	.311–.346	6.5	.072–.085	.434–.482
4.5	.057–.069	.338–.376	7.0	.074–.089	.454–.505

[1] For maintenance, 0.84.

[2] For maintenance, 9.51.

The amount of digestible crude protein and of the total digestible nutrients needed by the cows is obtained by adding to the requirements for maintenance the requirements for production. For example, the maintenance requirements of a 1,200-pound cow (table 4) are 0.84 pound of digestible crude protein and 9.51 pounds of total digestible nutrients. If the cow is daily producing 30 pounds of milk with butterfat testing 3.5 percent (table 5), her production requirements will vary from 1.47 to 1.83 pounds of digestible crude protein and from 8.52 to 9.48 pounds of total digestible nutrients, which is a total requirement ranging from 2.31 to 2.67 pounds of digestible crude protein and 18.03 to 18.99 pounds of total digestible nutrients. The figures for production requirements (table 5) allow latitude for individual cows of a given weight.

HINTS ON CALCULATING RATIONS

The following rations are calculated on the basis of digestible crude protein and total digestible nutrients daily required by a cow weighing 1,200 pounds and daily producing 30 pounds of milk testing 3.5 percent of butterfat. A 1,200-pound cow requires a minimum of 2.31 pounds of digestible crude protein and 18.03 pounds of total digestible nutrients (tables 4 and 5). Fed a ration composed of 12 pounds of oat-and-vetch hay (0.828 pound of digestible crude protein and 5.653 pounds of digestible nutrients), and 36 pounds of silage (1.01 pounds of digestible crude protein and 6.34 pounds of total digestible nutrients), such a cow will receive a total of 1.838 pounds of digestible crude protein and 11.993 pounds of total digestible nutrients. Reference to General Rules, page 10, shows that the cow, when fed 1 pound of hay and 3 pounds of silage for each 100 pounds of body weight, and 1 pound of concentrates for each 4 pounds of milk, needs approximately 12 pounds of hay, 36 pounds of silage, and 7½ pounds of grain.

Table 6 records the economy of feeding four rations.

TABLE 6.—*Economy of feeding 4 rations*

RATION NO. 1

Feed	Quantity of feed fed	Digestible crude protein	Total digestible nutrients	Cost of feed
	Pounds	*Pounds*	*Pounds*	*Cents*
Oat-and-vetch hay	12.0	0.828	5.652	27
Oat-and-pea silage	36.0	1.008	6.336	18
Corn	7.5	.562	6.536	34
Total	55.5	2.398	18.524	79

RATION NO. 2

Oat-and-vetch hay	12	0.828	5.652	27
Oat-and-pea silage	36	1.008	6.336	18
Barley grain	3	.270	2.382	9
Oat grain	3	.291	2.112	9
Linseed meal	1	.302	.779	5
Total	55	2.699	17.261	68

TABLE 6.—*Economy of feeding 4 rations*—Continued

RATION NO. 3

Feed	Quantity of feed fed	Digestible crude protein	Total digestible nutrients	Cost of feed
Oat-and-vetch hay	12	0.828	5.652	27
Oat-and-pea silage	36	1.008	6.336	18
Barley	3	.270	2.382	9
Oats	3	.291	2.112	9
Wheat bran	1	.125	.609	3
Total	55	2.522	17.091	66

RATION NO. 4

Oat-and-vetch hay	12	0.828	5.652	27
Oat-and-pea silage	36	1.008	6.336	18
Barley	5	.450	3.970	15
Oats	2	.194	1.408	6
Bran	1	.125	.609	3
Total	56	2.605	17.975	69

Ration no. 1 fulfills the requirements so far as digestible crude protein and total digestible nutrients are concerned, but the cost of the corn [6] makes the combination altogether too high for practicable purposes. Ration no. 2 replaces the corn with 3 pounds of barley, 3 pounds of oats, and 1 pound of linseed meal, and is lower in cost than ration no. 1, but the proportion of digestible crude protein to total digestible nutrients is too high. Ration no. 3 replaces the linseed meal with 1 pound of wheat bran and is somewhat lower in cost than ration no. 2, but the proportion of protein to digestible nutrients is still too high. In this ration ground rye might be economically used to replace a part of the oats if the former is to be had at a low price; or 4 pounds of silage and 3 pounds of hay might be used to replace 1 pound of barley without materially changing the cost or the proportion of digestible crude protein and total digestible nutrients. The addition of bran, primarily as a "conditioner", to ration no. 4 balances it at a reasonable cost.

If a ration is computed for the average cows in the herd and the feed mixtures are made up in proportion to the schedule, an individual cow will receive a greater or a smaller quantity of feed than will the average cows in the herd, depending on their requirements as determined by the herdsman.

WINTER FEEDING

The winter ration should as closely as possible simulate the summer ration, which is largely composed of grass. Some concentrates rich in protein should be added to rations low in this food constituent. Hays from cereals or from native grasses should be supplemented with some such concentrates as linseed meal or cottonseed meal to furnish the necessary protein. All concentrates should be ground. Considerable amounts of unground grain when fed may escape mastication, and consequently pass through the animal undigested.

[6] Corn cannot be grown anywhere in Alaska and must be shipped in from the States.

When the herdsman does not care to calculate his rations too closely, he should compare his winter feeding schedule with one of the economical combinations shown in table 7.

TABLE 7.—*Economical rations for winter feeding of dairy cows*

Feed	Quantity of feed	Cost of feed
RATION A		
	Pounds	*Dollars*
Rolled barley	250	7.50
Rolled oats	100	3.00
Wheat bran	50	1.50
Total	400	12.00
Cost of feed mixture per pound		.03
RATION B		
Rolled oats	300	9.00
Ground corn	200	9.00
Ground wheat	100	3.00
Total	600	21.00
Cost of feed mixture per pound		.035
RATION C		
Rolled oats	300	9.00
Rolled barley	400	12.00
Linseed meal	350	17.50
Total	1,050	38.50
Cost of feed mixture per pound		.0366
RATION D		
Rolled barley	400	12.00
Wheat bran	200	5.00
Linseed meal	300	15.00
Total	900	32.00
Cost of feed mixture per pound		.0355
RATION E		
Rolled oats	400	12.00
Rolled barley	400	12.00
Wheat bran	200	6.00
Linseed meal	200	10.00
Total	1,200	40.00
Cost of feed mixture per pound		.0333
RATION F		
Rolled barley	300	9.00
Ground oats	300	9.00
Linseed meal	200	10.00
Total	800	28.00
Cost of feed mixture per pound		.035

Suggestion no. 1.—If hay and silage are fed in the proportion of 1 pound of oat-and-vetch hay to 3 pounds of oat-and-pea silage, one of the mixtures (ration A or B) may be fed at the rate of 1 pound of the concentrate to each 3 or 4 pounds of milk produced.

One pound of linseed meal should be added to the rations for cows daily giving 1 pound of butterfat or more. If no silage is fed, the amount of hay should be doubled and the proportion of concentrates should be increased to one fourth again as much as they were previously.

Suggestion no. 2.—When 20 to 40 pounds of timothy hay or of wild grass hay is fed without silage or roots one of the grain mixtures (ration C) may be used. This is the best dry feed ration for Alaska, but it cannot be recommended for dairy cows for any great length of time.

Suggestion no. 3.—When 15 to 30 pounds of roots per animal are used to replace half the quantity of the above-mentioned hay ration, one of the mixtures (ration D or E) may be used.

Suggestion no. 4.—When cows in milk are fed all the good oat-and-vetch hay and oat-and-pea silage they will readily take, one of the concentrate mixtures (ration F) should be used to supply the needed nutrients to maintain a good milk flow.

GENERAL RULES

Two pounds of hay, or 1 pound of hay and 3 pounds of silage, or 3 pounds of silage, 3 pounds of roots, and one half pound of hay, or 6 pounds of roots and 1 pound of hay, should be fed per 100 pounds of body weight.

Ordinarily cows will daily eat per head approximately 2 pounds of roughage per 100 pounds of body weight. Usually the proportion of roughage fed depends on the size of the cows, whereas concentrates are fed in proportion to the amount of milk they produce (table 1).

Cows should be given 1 pound of concentrates for every 3 or 4 pounds of milk they produce. Fresh cows should be fed increasing amounts of concentrates until they fail to respond by an increase in milk yield. The quantity should then be slightly decreased to keep them from getting off feed.

Cows daily producing 1 or more pounds of butterfat should receive one half pound to 2 pounds more of a good concentrate, preferably linseed meal, than do cows giving less than 1 pound of butterfat.

Dairy cows in milk exhibiting tendencies to fatten should be fed a liberal amount of protein feed (tables 1 and 4), with a decreasing proportion of starchy feed. This will stimulate milk production and cause the animals to lose in weight.

Determining and recording the weight of each cow's milk at each milking will enable the herdsman to know the approximate kind and amount of feed she needs.

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